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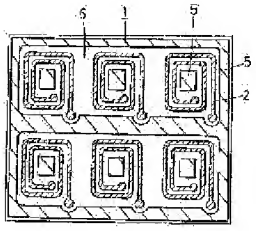
(54) MANUFACTURE OF MULTILAYER BOARD FOR PRINTED COIL



(57)Abstract:
PROBLEM TO BE SOLVED: To provide a printed coil excellent in voltage resistance by forming a dummy pattern on the face excluding the section where a coil pattern with a specified thickness is made out of the surface of a board, and specifying the ratio of the total area of a coil pattern and a dummy pattern to the board area of the pattern formation face.
SOLUTION: Coil patterns 2 and 2 about 90-150μm in thickness made on the surfaces of two or more sheets of boards 1 and 1 are stacked face to face with a prepreg between, and then they are heated and pressed, and an interboard insulating layer about 40-80μm in thickness is made

between the opposed coil patterns 2 and 2 about 90-150μm in thickness, and the boards 1 and 1 are bonded to make a multiboard. At this time, a dummy pattern 5 is made on the face excluding the section of the coil pattern 2 about 90-150μm in thickness of the board, and the ratio of the total area of the coil pattern 2 and the dummy pattern 5 to the area of the board 1 at the face of the coil pattern 2 is made about 80-950%. Hereby, a printed wiring board excellent in voltage resistance can be obtained.

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CLAIMS

[Claim(s)]

[Claim 1] Two or more substrates of an organic system which formed the

coil pattern with a thickness of 90-150 micrometers in the front face at least two of them, After carrying out the laminating of a substrate and the prepreg so that a coil pattern with a thickness of 90-150 micrometers which formed thermosetting resin in the substrate front face using the prepreg which sank into glass fabrics may face each other on both sides of prepreg in between, In the manufacture approach of the multilayer board for printed coils which forms the insulating layer with a thickness of 40-80 micrometers between substrates, and a substrate pastes up, and is manufactured while a coil pattern with a thickness of 90-150 micrometers faces each other by carrying out heating pressurization The substrate in which the coil pattern with a thickness of 90-150 micrometers which forms the insulating layer with a thickness of 40-80 micrometers between substrates, and is pasted up was formed on the front face, A dummy pattern is formed in the front face except the part which formed the coil pattern among the front faces in which the coil pattern with a thickness of 90-150 micrometers was formed. The manufacture approach of the multilayer board for printed coils characterized by making into 80 - 95% the ratio of the sum total area of the coil pattern to the area of the substrate of the field in which the coil pattern was formed, and a dummy pattern.

[Claim 2] The manufacture approach of the multilayer board for printed coils according to claim 1 that the front face of the substrate except a coil pattern and a dummy pattern is characterized by forming a dummy pattern so that it may be connected with the end face of the substrate among the front faces in which the coil pattern with a thickness of 90-150 micrometers of the substrate in which the coil pattern with a thickness of 90-150 micrometers which forms the insulating layer with a thickness of 40-80 micrometers between substrates, and is pasted up was formed on the front face was formed.

[Claim 3] That area 1-25 square mm has the circular configuration of a dummy pattern, and/or the manufacture approach of the multilayer board for printed coils according to claim 1 or 2 characterized by a square shape being the configuration by which two or more formation was carried out.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of the multilayer board used for manufacture of a printed coil.
[0002]
[Description of the Prior Art] The printed coil manufactured using the manufacture approach of a printed wired board as the object for transformer coils, an object for choke coils, etc. is used. Since thin-shape-izing is possible or the thing of uniform quality is easy to be obtained as compared with the coil which carried out the coil of the conventional enameled wire etc., and manufactured it, this printed coil is being used for a large application.
[0003] It is manufactured by the approach using the multilayer board which has a coil pattern which is indicated by JP,58-155711,A and JP,60-245208,A, for example in a inner layer as the manufacture approach of this printed coil.
[0004] As this approach, the metallic foil of organic system substrate front faces, such as for example, a metallic foil flare laminate, is etched. Two or more substrates which formed the coil pattern of the curled form which was crooked or curved as shown in drawing 5 , and formed this coil pattern, After arranging a substrate so that the coil pattern which formed thermosetting resin, such as an epoxy resin, in the substrate front face using the prepreg which sank in may face base materials, such as glass fabrics, between the substrate After carrying out a laminating on both sides of prepreg and allotting and carrying out the laminating of the above-mentioned prepreg or the metallic foil to one side or the both sides of the laminated material if needed, by carrying out heating pressurization, an insulating layer is formed between coil patterns etc. and a multilayer board is manufactured. Subsequently, after making the hole penetrated to this multilayer board, it plates the front face of that multilayer board, and inside a hole, a metallic film is formed, between circuits etc. is connected with a desired coil pattern, and, subsequently the printed coil is manufactured

by the approach of, making the hole which inserts a magnetic core or forming a solder resist layer if needed. [the approach] [forming a coil pattern also on the surface of a multilayer board] Moreover, when the magnitude of a coil pattern is small, in order to raise productivity, the approach of manufacturing a multilayer board using the substrate in which two or more coil patterns were formed on the substrate front face as shown in drawing 6 , and cutting for every coil pattern finally and manufacturing is also performed.

[0005] The printed coil which enlarged current capacity which thickens thickness of the metallic foil which forms a coil pattern, and passes it, and the printed coil which raised conversion efficiency by making thickness of the insulating layer between substrates thin, and shortening distance by the side of a primary winding and a secondary winding are demanded with advanced features of electronic equipment in recent years etc.

[0006] However, the thickness of the metallic foil which forms such a coil pattern was thick, withstand voltage may fall between the coil patterns of the both sides of an insulating layer with thin thickness, and the printed coil using a multilayer board with the thin thickness of the insulating layer between substrates had the problem that electric dependability was low. Therefore, even if the thickness of the metallic foil which forms a coil pattern is thick and is the case that the thickness of the insulating layer between substrates is thin, the manufacture approach of the multilayer board for printed coils that the printed coil excellent in withstand voltage is obtained is searched for.

[0007]

[Problem(s) to be Solved by the Invention] The place which accomplished this invention in order to improve the above-mentioned trouble, and is made into the purpose Two or more substrates of an organic system which formed the coil pattern with a thickness of 90-150 micrometers in the front face at least two of them, After carrying out the laminating of a substrate and the prepreg so that a coil pattern with a thickness of 90-150 micrometers which formed thermosetting resin in the substrate front face using the prepreg which sank into glass fabrics may face each other on both sides of prepreg in between, It is the manufacture approach of the multilayer board for printed coils which forms the insulating layer with a thickness of 40-80 micrometers between substrates between coil patterns with a thickness of 90-150 micrometers which faces each other by carrying out heating pressurization, and a substrate pastes up, and is manufactured. It is in offering the manufacture approach of the multilayer board for printed coils that the printed coil excellent in

withstand voltage is obtained.
[0008]
[Means for Solving the Problem] In order to solve said technical problem, as a result of repeating examination, artificers found out that the ratio of the sum total area of the coil pattern to the area of the substrate in which the coil pattern with a thickness of 90-150 micrometers was formed on the front face, and other patterns was one of the causes by which withstand voltage deteriorates, and solved the technical problem.
[0009] The manufacture approach of the multilayer board for printed coils concerning claim 1 of this invention Two or more substrates of an organic system which formed the coil pattern with a thickness of 90-150 micrometers in the front face at least two of them, After carrying out the laminating of a substrate and the prepreg so that a coil pattern with a thickness of 90-150 micrometers which formed thermosetting resin in the substrate front face using the prepreg which sank into glass fabrics may face each other on both sides of prepreg in between, In the manufacture approach of the multilayer board for printed coils which forms the insulating layer with a thickness of 40-80 micrometers between substrates, and a substrate pastes up, and is manufactured while a coil pattern with a thickness of 90-150 micrometers faces each other by carrying out heating pressurization The substrate in which the coil pattern with a thickness of 90-150 micrometers which forms the insulating layer with a thickness of 40-80 micrometers between substrates, and is pasted up was formed on the front face, A dummy pattern is formed in the front face except the part which formed the coil pattern among the front faces in which the coil pattern with a thickness of 90-150 micrometers was formed. It is characterized by making into 80 - 95% the ratio of the sum total area of the coil pattern to the area of the substrate of the field in which the coil pattern was formed, and a dummy pattern.
[0010] The manufacture approach of the multilayer board for printed coils concerning claim 2 of this invention In the manufacture approach of the multilayer board for printed coils according to claim 1, form the insulating layer with a thickness of 40-80 micrometers between substrates, and paste up. The inside of the front face in which the coil pattern with a thickness of 90-150 micrometers of the substrate in which the coil pattern with a thickness of 90-150 micrometers was formed on the front face was formed, The front face of the substrate except a coil pattern and a dummy pattern is characterized by forming a dummy pattern so that it may be connected with the end face of the substrate.

[0011] In the manufacture approach of the multilayer board for printed coils according to claim 1 or 2, as for the manufacture approach of the multilayer board for printed coils concerning claim 3 of this invention, the configuration of a dummy pattern is characterized by circular and/or the thing [a square shape / the configuration by which two or more formation was carried out] of mm square [of area / 1-25].
[0012]
[Embodiment of the Invention] The manufacture approach of the multilayer board for printed coils concerning this invention is explained based on a drawing. It is a sectional view [explain the process of the gestalt of the 1 operation of the manufacture approach of the multilayer board for printed coils / that be drawing / explain the gestalt of other operations further / of the configuration of a coil / that be drawing / explain the gestalt of the operation of everything but the configuration of a coil / that drawing 1 be drawing / explain the gestalt of 1 of the configuration of a coil / start this invention / pattern and a dummy pattern operation / , and drawing 2 start this invention / pattern , and dummy pattern / , and drawing 3 start this invention / pattern , and dummy pattern , and drawing 4 start this invention] .
[0013] The manufacture approach of the multilayer board for printed coils of this invention To at least two of them, as two or more substrates of an organic system in which the conductor pattern with a thickness of 90-150 micrometers was formed on the front face, and thermosetting resin are shown in drawing 4 (a) using the prepreg which sank into glass fabrics After carrying out the laminating of substrates 1 and 1 and the prepreg 3 so that a substrate 1 and the coil patterns 2 and 2 with a thickness of 90-150 micrometers formed in one front face may face each other on both sides of prepreg 3 in between, by carrying out heating pressurization As shown in drawing 4 (b), while the coil patterns 2 and 2 with a thickness of 90-150 micrometers face each other, the insulating layer 4 with a thickness of 40-80 micrometers between substrates is formed, substrates 1 and 1 paste up, and a multilayer board is manufactured.
[0014] The substrate in which the coil pattern 2 with a thickness of 90-150 micrometers which forms the insulating layer 4 with a thickness [this] of 40-80 micrometers between substrates, and is pasted up was formed on the front face The inside of the front face which formed the coil pattern 2 with a thickness of 90-150 micrometers of a substrate 1 as shown in drawing 1 , It is important to make into 80 - 95% the ratio of the sum total area of the coil pattern 2 to the area of the substrate 1 of the field which formed the dummy pattern 5 in the front face except

the part in which the coil pattern 2 was formed, and formed the coil pattern 2, and the dummy pattern 5. When the ratio of sum total area is less than 80%, since withstand voltage may fall, it becomes a problem, and if it is going to form the dummy pattern 5 so that 95% may be exceeded, the coil pattern 2 and the dummy pattern 5 may contact, and an electrical property may fall.

[0015] Although it does not limit especially as a configuration of the dummy pattern 5, in addition, by closing a perimeter with the coil pattern 2 or the dummy pattern 5 The part of the front face 6 of the substrate except the coil pattern 2 and the dummy pattern 5 is isolated, and when carrying out heating pressurization and the resin made from heat curing of prepreg flows toward an edge from the center section of a substrate 1 The inside of the front face which formed the coil pattern of a substrate 1 as shown in drawing 2 so that air bubbles might not remain into the isolated part, A moldability excels and is desirable, when the front face 6 of the substrate except the coil pattern 2 and the dummy pattern 5 forms the dummy pattern 5 so that it may be connected with the end face 7 of the substrate 1. In addition, the front face 6 of the substrate here excluding ["the front face 6 of the substrate except the coil pattern 2 and the dummy pattern 5 is connected with the end face 7 of the substrate 1"] the coil pattern 2 and the dummy pattern 5 means that the perimeter is closed neither with the coil pattern 2 nor the dummy pattern 5. Moreover, as shown in drawing 3 , that mm is [square / 1-25 / of area] circular, or when arranging two or more patterns of square shapes, such as a triangle and a square, and forming them, on substrate 1 front face, the coil pattern 2 and the dummy pattern 5 can be mostly arranged to homogeneity, and it excels and is desirable [especially withstand voltage].

[0016] In addition, at least two of the substrates 1 of an organic system with which this invention formed the coil pattern 2 in the front face are limited when it is the substrate 1 in which the coil pattern 2 with a thickness of 90-150 micrometers was formed on the front face. When the number of sheets of the substrate 1 in which the 90-150-micrometer coil pattern 2 was formed on the front face is less than two sheets, the electric capacity which becomes small and can pass the cross section of the coil pattern 2 falls, and if an electrical property falls, or width of face of the coil pattern 2 tends to be enlarged and it is going to satisfy electric capacity, the magnitude of a multilayer board will become large and will pose a problem in price.

[0017] Moreover, it is limited, when forming the insulating layer with a thickness of 40-80 micrometers between substrates while heating

pressurization is carried out and the coil pattern 2 with a thickness of 90-150 micrometers faces each other. the case where withstand voltage may fall and 80 micrometers is exceeded when the thickness of the insulating layer between this substrate is less than 40 micrometers -- electromagnetism -- electrical properties, such as conversion efficiency, may fall

[0018] As a substrate 1 of the organic system in which the coil pattern 2 used for this invention was formed on the front face That what is necessary is just the plate of the organic system in which the coil pattern 2 was formed to one side or both sides For example, an epoxy resin system, a phenol resin system, a polyimide resin system, an unsaturated-polyester-resin system, The plate with which the metallic foil is stretched to one side or both sides of a sheet although the inorganic filler etc. was blended with thermosetting resin, such as a polyphenylene ether resin system, and these thermosetting resin, The cross of organic fiber, such as inorganic fibers, such as glass, polyester, a polyamide, and cotton, Paste up base materials, such as a paper, with the above-mentioned thermosetting resin etc., and the plate with which the metallic foil is stretched to one side or both sides is used. Metal plating is performed on the front face of the thing which etched the metallic foil and formed the coil pattern 2, and the plate with which the metallic foil is not stretched, and the thing in which the coil pattern 2 was formed etc. is mentioned. In addition, as a metal which forms the coil pattern 2, copper is more desirable than electric dependability. In addition, this substrate 1 may have the hole which may have the coil pattern 2 and other circuit patterns also inside if needed, and formed the electric conduction coat in that wall surface.

[0019] The prepreg used for this invention sinks thermosetting resin into glass fabrics, and as the thermosetting resin, for example like independence, such as an epoxy resin system, a phenol resin system, a polyimide resin system, an unsaturated-polyester-resin system, and a polyphenylene ether resin system, a denaturation object, and mixture, thermosetting resin at large is mentioned and it may contain fiber fillers, such as minerals powder fillers, such as a silica, a calcium carbonate, an aluminum hydroxide, and talc, and a glass fiber, pulp fiber, a synthetic fiber, ceramic fiber, if needed. In addition, after sinking into glass fabrics, stoving of this thermosetting resin may be carried out if needed.

[0020] In addition, the ratio of the thermosetting resin in the prepreg which carried out the laminating between the substrates 1 with which the coil pattern 2 with a thickness of 90-150 micrometers faces each other

is desirable in the amount of thermosetting resin being 60 - 90 weight section to thermosetting resin and a total of 100 weight sections of glass fabrics.

[0021] After carrying out a laminating on both sides of prepreg between substrates 1, as conditions which carry out heating pressurization Although what is necessary is to adjust suitably and just to carry out heating pressurization on the conditions which the thermosetting resin of prepreg hardens, if the pressure of pressurization is high, distortion will occur to the coil pattern 2, and they are two or more substrates 1 and 1.. Since location gap may occur in between and an electrical property may fall, Within limits which satisfy a moldability, it is desirable to pressurize with low voltage as much as possible. In addition, a moldability becomes good and is desirable when heating pressurization is performed under the reduced pressure ambient atmosphere of 300 or less Torrs.

[0022] If needed, after carrying out heating pressurization, as shown in drawing 4 (c), form the hole 10 which penetrates the coil pattern 2 in the multilayer board obtained by carrying out heating pressurization, and plating etc. gives the conductive matter 11 to it in this hole 10. Between the desired coil patterns 2 and between other circuit patterns are connected electrically, or a surface metallic foil is etched, the surface circuit 12 is formed, or a solder resist layer is formed on the surface circuit 12, and a printed coil is manufactured.

[0023] In addition, the substrate 1 in which the coil pattern 2 with a thickness of 90-150 micrometers was formed is not limited to two sheets, may be carrying out the laminating of the substrate 1 in which further two or more 90-150-micrometer coil patterns 2 were formed, on both sides of prepreg, and may be carrying out the laminating of the substrate 1 in which the coil pattern with a thickness of less than 90 micrometers was formed. Moreover, the laminating of prepreg or the metallic foil may be carried out to one side or the both sides of laminated material which carried out the laminating of a substrate 1 and the prepreg so that it might face each other on both sides of prepreg in between. In addition, the substrate 1 of a part which forms the insulating layer with a thickness of 40-80 micrometers between substrates, and is pasted up while the coil pattern 2 with a thickness of 90-150 micrometers faces each other also in these cases A dummy pattern is formed in the front face except the part which formed the coil pattern 2 among the front faces in which the coil pattern 2 with a thickness of 90-150 micrometers was formed. It is important to make into 80 - 95% the ratio of the sum total area of the coil pattern 2 to the area of the substrate 1 of the

field in which the coil pattern 2 was formed, and a dummy pattern.
[0024]
[Example]
Only one field etches two copper foil of the two substrates using Matsushita Electric Works, Ltd. make and name-of-article R1766].
(Example 1) with 105-micrometer [in copper foil thickness], and a thickness [of the insulating section] of 0.1mm epoxy resin double-sided copper-clad laminate [-- The substrate formed in the front face except the part which formed the coil pattern for six curled form coil patterns with a width of face [of a conductor / of 1mm] and a width of face [of the etching removal section] of 1mm and a pattern with mm circular [square / 12 / of much area as shown as a dummy pattern at drawing 3] in one field was obtained.
[0025] It was 85% when asked for the ratio of the sum total area of the coil pattern to the area of the substrate of the field in which the coil pattern of the obtained substrate was formed, and a dummy pattern. In addition, this ratio found the weight after removing completely the copper foil of the field which etched only the weight of the substrate before forming a coil pattern, the weight after etching only one field and forming a coil pattern and a dummy pattern, and one field, and formed the coil pattern and the dummy pattern by measuring and calculating weight using the same epoxy resin double-sided copper-clad laminate as the above.
[0026] Moreover, after it adjusted and the amount of the thermosetting resin after desiccation sank in to thermosetting resin and a total of 100 weight sections of glass fabrics so that it might become 70 weight sections, stoving of the epoxy system resin which becomes glass fabrics [the product made from Asahi SHUEBERU, Inc. and a name of article 1080] with a thickness of 0.04mm from two kinds of epoxy resins, a curing agent, a following hardening accelerator, and two kinds of following solvents was carried out at 180 degrees C of maximum temperatures, and Prepreg A was manufactured.
- Epoxy resin 1 : they are [dicyandiamide / 13 weight section and / curing agent:/ 2-ethyl-4-methylimidazole / the 2.8 weight section and / hardening-accelerator:] the 200 weight sections about 55 weight section and a solvent 2:methyl ethyl ketone in the 0.1 weight section and solvent 1:N.N-dimethylformamide, using as solid content the cresol novolak mold epoxy resin [the Tohto Kasei Co., Ltd. make and trade name YDCN-220] whose 94 weight section and epoxy resin 2:weight per epoxy equivalent are 220 by making into solid content the tetrabromobisphenol A mold epoxy resin [the Tohto Kasei Co., Ltd. make and trade name YDB-

500] whose weight per epoxy equivalent is 500.
[0027] Subsequently, after having arranged the substrate so that a coil pattern with a thickness of 105 micrometers formed in the substrate front face may face each other, after performing roughening processing to this substrate, on both sides of the thickness above-mentioned prepreg A, the laminating of the two sheets was carried out between that substrate, subsequently this laminated material was inserted on the metal plate, heating pressurization was carried out for 90 minutes on condition that 170 degrees C of maximum temperatures, and pressure 3MPa, and the multilayer board was obtained.
[0028] After cutting the obtained multilayer board in a part with a coil pattern, exposing the cross section of a coil pattern and grinding a cutting plane, it was 70 micrometers, when it observed under the 100 times as many microscope as this, five thickness of the insulating layer between substrates of the part which a coil pattern with a thickness of 105 micrometers faces was measured and the average was calculated.
[0029] It adjusted and the amount of the thermosetting resin after desiccation sank in so that it might become 65 weight sections to thermosetting resin and a total of 100 weight sections of glass fabrics, and Prepreg B was manufactured, (Example 2) And after having arranged the substrate so that a coil pattern with a thickness of 105 micrometers formed in the substrate front face may face each other, the multilayer board was obtained like the example 1 except having carried out the laminating of the two sheets on both sides of Prepreg B between the substrate, and having performed heating pressurization under the reduced pressure ambient atmosphere of 50Torr(s).
[0030] It was 65 micrometers when the thickness of the insulating layer between substrates of the part which a coil pattern with a thickness of 105 micrometers faces like an example 1 in the obtained multilayer board was measured.
[0031] (Example 1 of a comparison) Only one field etched the copper foil of a substrate and the multilayer board was obtained like the example 1 except having used the substrate in which only six curled form coil patterns with a width of face [of a conductor / of 1mm] and a width of face [of the etching removal section] of 1mm were formed to one field. It was 50% when asked for the ratio of the coil pattern to the area of the substrate of the field in which the coil pattern of the obtained substrate was formed.
[0032] It was 50 micrometers when the thickness of the insulating layer between substrates of the part which a coil pattern with a thickness of 105 micrometers faces like an example 1 in the obtained multilayer board

was measured.

[0033] (Example 2 of a comparison) The multilayer board was obtained like the example 1 except having used the substrate which changed and formed the configuration of a dummy pattern by reducing the number of the circular patterns of mm square [of area / 12]. It was 70% when asked for the ratio of the sum total area of the coil pattern to the area of the substrate of the field in which the coil pattern of the obtained substrate was formed, and a dummy pattern.

[0034] It was 60 micrometers when the thickness of the insulating layer between substrates of the part which a coil pattern with a thickness of 105 micrometers faces like an example 1 in the obtained multilayer board was measured.

[0035] (Evaluation, result) The withstand voltage of a multilayer board and thermal resistance which were obtained in examples 1 and 2 and the examples 1 and 2 of a comparison were measured. Measurement of withstand voltage exposed the part by shaving off the copper foil of the field which did not form the part and coil pattern which were the insulating section of a copper-clad laminate respectively about the coil pattern of two used substrates. Subsequently, the electrical potential difference was impressed on the pressure-up conditions of per second 100 V from the part of the coil pattern which exposed this multilayer board in part between the coil patterns of two used substrates in the condition of having been immersed into the oil kept warm by 23**5 degrees C, and the electrical potential difference in which dielectric breakdown occurs was measured. Heat-resistant measurement is JIS. According to C6481, it processed in oven for 60 minutes.

[0036] Each example is excellent in withstand voltage as compared with each example of a comparison, and it was checked that withstand voltage is equivalent as the result was shown in Table 1.

[0037]

[Table 1]

表1

	実施例		比較例	
	1	2	1	2
銅箔厚み (μm)	105	105	105	105
ﾊﾟﾀｰﾝ比率 (%)	85	85	50	70
プリプレグ	A	B	A	A
樹脂比率 (%)	70	65	70	70
ﾌﾟﾘﾌﾟﾚｸﾞ枚数 (枚)	2	2	2	2
基板間絶縁層の厚み (μm)	70	65	50	60
耐電圧 (kV)	5.0	5.3	0.7	1.2
耐熱性 (℃)	235	235	220	225

[0038]
[Effect of the Invention] Since the glass fabrics of the prepreg which sandwiched between conductor patterns with a thickness of 90-150 micrometers which faces each other, and carried out the laminating are glass fabrics with a weight [m] of 15-60g [/square] and there is 2-5 number of sheets of the prepreg, the manufacture approach of the multilayer board for printed coils concerning this invention can obtain the printed wired board excellent in withstand voltage.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing explaining the gestalt of 1 operation of the configuration of the coil pattern concerning this invention, and a dummy pattern.
[Drawing 2] It is drawing explaining the gestalt of other operations of the configuration of the coil pattern concerning this invention, and a dummy pattern.
[Drawing 3] It is drawing of the configuration of the coil pattern concerning this invention, and a dummy pattern which explains the gestalt of other operations further.
[Drawing 4] It is a sectional view explaining the process of the gestalt of 1 implementation of the manufacture approach of the multilayer board for printed coils concerning this invention.
[Drawing 5] It is drawing explaining the 1 conventional example of a coil pattern.
[Drawing 6] It is drawing explaining other conventional examples of a coil pattern.

[Description of Notations]
1 Substrate
2 Coil Pattern
3 Prepreg
4 Insulating Layer between Substrates
5 Dummy Pattern

[Translation done.]

* NOTICES *

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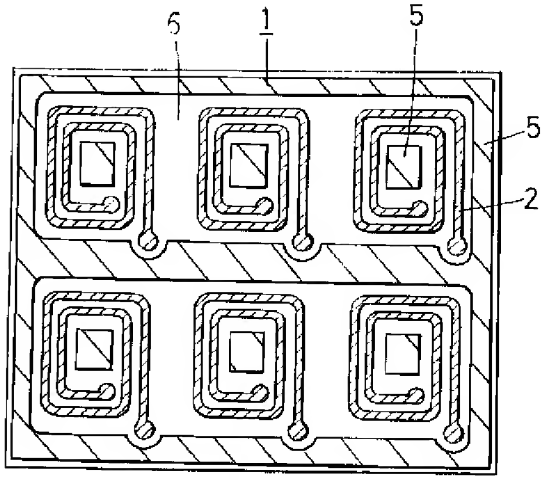
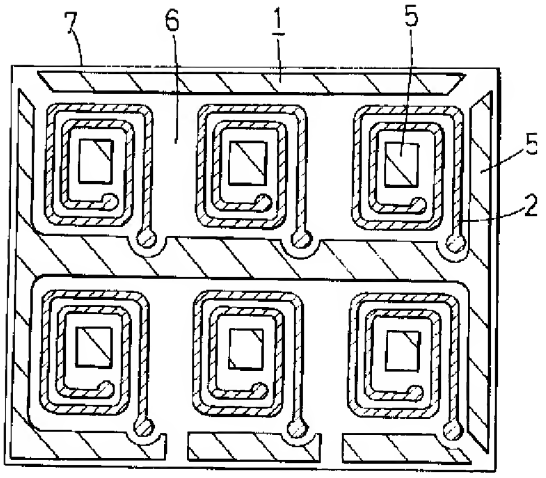
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

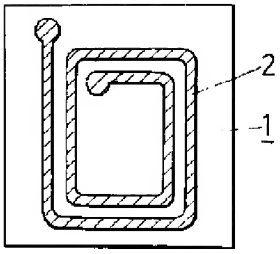
[Drawing 1]



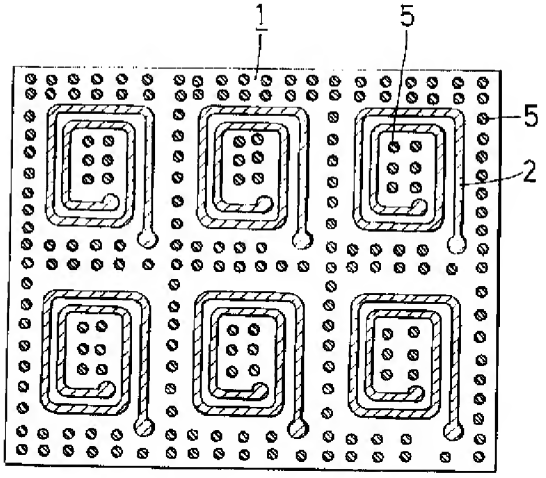
[Drawing 2]



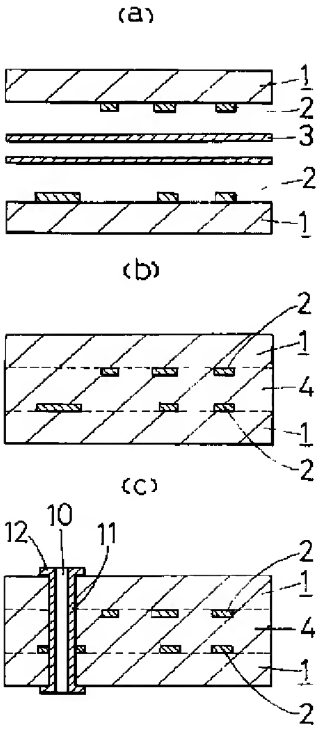
[Drawing 5]



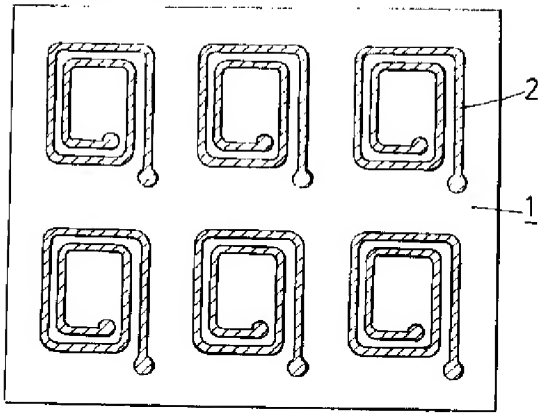
[Drawing 3]



[Drawing 4]



[Drawing 6]



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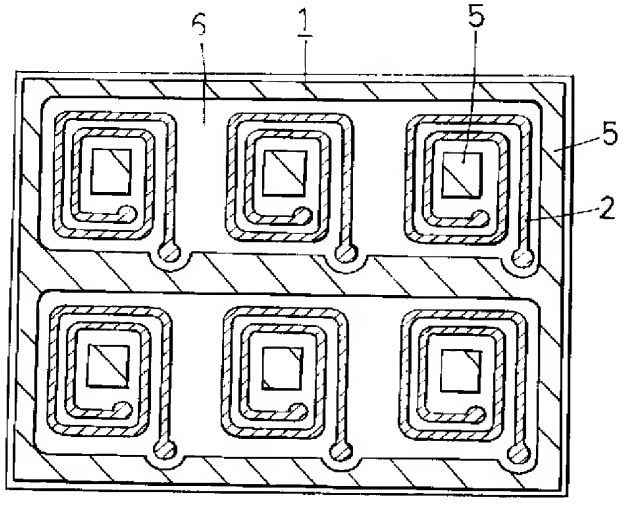
(54)【発明の名称】　プリントコイル用多層板の製造方法

(57)【要約】

【課題】　向かい合う厚み９０～１５０μｍのコイルパターンの間に厚み４０～８０μｍの基板間絶縁層を形成して基板が接着されて製造するプリントコイル用多層板の製造方法であって、耐電圧が優れたプリントコイルが得られるプリントコイル用多層板の製造方法を提供する。

【解決手段】　厚み４０～８０μｍの基板間絶縁層を形成して接着される、厚み９０～１５０μｍのコイルパターンを表面に形成した基板の、厚み９０～１５０μｍのコイルパターンを形成した表面のうち、コイルパターンを形成した部分を除く表面にダミーパターンを形成し、コイルパターンを形成した面の基板の面積に対する、コイルパターン及びダミーパターンの合計面積の比率を８０～９５％とする。



【特許請求の範囲】
【請求項１】　その中の少なくとも２枚には厚み９０～１５０μｍのコイルパターンを表面に形成した複数枚の有機系の基板と、熱硬化性樹脂をガラスクロスに含浸したプリプレグとを用いて、基板表面に形成した厚み９０～１５０μｍのコイルパターンがプリプレグを間に挟んで向かい合うように基板及びプリプレグを積層した後、加熱加圧することにより、厚み９０～１５０μｍのコイルパターンが向かい合う間に厚み４０～８０μｍの基板間絶縁層を形成して基板が接着されて製造するプリントコイル用多層板の製造方法において、厚み４０～８０μｍの基板間絶縁層を形成して接着される、厚み９０～１５０μｍのコイルパターンを表面に形成した基板の、厚み９０～１５０μｍのコイルパターンを形成した表面のうち、コイルパターンを形成した部分を除く表面にダミーパターンを形成し、コイルパターンを形成した面の基板の面積に対する、コイルパターン及びダミーパターンの合計面積の比率を８０～９５％とすることを特徴とするプリントコイル用多層板の製造方法。
【請求項２】　厚み４０～８０μｍの基板間絶縁層を形成して接着される、厚み９０～１５０μｍのコイルパターンを表面に形成した基板の、厚み９０～１５０μｍのコイルパターンを形成した表面のうち、コイルパターン及びダミーパターンを除く基板の表面が、その基板の端面とつながるようにダミーパターンを形成することを特徴とする請求項１記載のプリントコイル用多層板の製造方法。
【請求項３】　ダミーパターンの形状が、面積１～２５平方ｍｍの円形及び／又は角形が複数形成された形状であることを特徴とする請求項１又は請求項２記載のプリントコイル用多層板の製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、プリントコイルの製造に使用される多層板の製造方法に関するものである。
【０００２】
【従来の技術】トランスコイル用やチョークコイル用等として、プリント配線板の製造方法を用いて製造されるプリントコイルが用いられている。このプリントコイルは、従来のエナメル線等を巻線して製造したコイルと比較して薄型化が可能であったり、均一な品質のものが得られやすいため広い用途に使用されつつある。
【０００３】このプリントコイルの製造方法としては、例えば特開昭５８－１５５７１１号や特開昭６０－２４５２０８号に記載されているような、コイルパターンを内層に有する多層板を用いる方法で製造されている。
【０００４】この方法としては例えば、金属箔張り積層板等の有機系基板表面の金属箔をエッチングして、図５に示すような、屈曲したり湾曲した渦巻き状のコイルパターンを形成し、このコイルパターンを形成した複数の基板と、ガラスクロス等の基材にエポキシ樹脂等の熱硬化性樹脂を含浸したプリプレグとを用いて、基板表面に形成したコイルパターンが向かい合うように基板を配置した後、その基板の間に、プリプレグを挟んで積層し、必要に応じて上記プリプレグや金属箔をその積層物の片側又は両側に配して積層した後、加熱加圧することにより、コイルパターンの間等に絶縁層を形成して多層板を製造する。次いでこの多層板に貫通する穴をあけた後、その多層板の表面及び穴の内部にメッキを行って金属皮膜を形成して所望のコイルパターンと回路間等を接続し、次いで必要に応じて多層板の表面にもコイルパターンを形成したり、磁芯を挿入する穴を開けたり、ソルダーレジスト層を形成する方法でプリントコイルは製造されている。また、コイルパターンの大きさが小さい場合には、生産性を高めるために、図６に示すような、基板表面にコイルパターンを複数形成した基板を用いて多層板を製造し、最後にコイルパターン毎に切断して製造する方法も行われている。
【０００５】近年の電子機器の高機能化等に伴い、コイルパターンを形成する金属箔の厚みを厚くして流す電流容量を大きくしたプリントコイルや、基板と基板の間の絶縁層の厚みを薄くして、一次巻線側と二次巻線側の距離を短くすることにより変換効率を高めたプリントコイルが要求されている。
【０００６】しかしこのような、コイルパターンを形成する金属箔の厚みが厚く、基板と基板の間の絶縁層の厚みが薄い多層板を用いたプリントコイルは、厚みが薄い絶縁層の両側のコイルパターン間で耐電圧が低下する場合があり、電気的信頼性が低いという問題があった。そのため、コイルパターンを形成する金属箔の厚みが厚く、基板と基板の間の絶縁層の厚みが薄い場合であっても、耐電圧が優れたプリントコイルが得られるプリントコイル用多層板の製造方法が求められている。
【０００７】
【発明が解決しようとする課題】本発明は、上記問題点を改善するために成されたもので、その目的とするところは、その中の少なくとも２枚には厚み９０～１５０μｍのコイルパターンを表面に形成した複数枚の有機系の基板と、熱硬化性樹脂をガラスクロスに含浸したプリプレグとを用いて、基板表面に形成した厚み９０～１５０μｍのコイルパターンがプリプレグを間に挟んで向かい合うように基板及びプリプレグを積層した後、加熱加圧することにより、向かい合う厚み９０～１５０μｍのコイルパターンの間に厚み４０～８０μｍの基板間絶縁層を形成して基板が接着されて製造するプリントコイル用多層板の製造方法であって、耐電圧が優れたプリントコイルが得られるプリントコイル用多層板の製造方法を提供することにある。
【０００８】

【課題を解決するための手段】前記課題を解決するために発明者らは検討を重ねた結果、厚み９０～１５０μｍのコイルパターンを表面に形成した基板の面積に対する、コイルパターン及びその他のパターンの合計面積の比率が、耐電圧が劣下する原因の一つであることを見い出し課題を解決した。

【０００９】本発明の請求項１に係るプリントコイル用多層板の製造方法は、その中の少なくとも２枚には厚み９０～１５０μｍのコイルパターンを表面に形成した複数枚の有機系の基板と、熱硬化性樹脂をガラスクロスに含浸したプリプレグとを用いて、基板表面に形成した厚み９０～１５０μｍのコイルパターンがプリプレグを間に挟んで向かい合うように基板及びプリプレグを積層した後、加熱加圧することにより、厚み９０～１５０μｍのコイルパターンが向かい合う間に厚み４０～８０μｍの基板間絶縁層を形成して基板が接着されて製造するプリントコイル用多層板の製造方法において、厚み４０～８０μｍの基板間絶縁層を形成して接着される、厚み９０～１５０μｍのコイルパターンを表面に形成した基板の、厚み９０～１５０μｍのコイルパターンを形成した表面のうち、コイルパターンを形成した部分を除く表面にダミーパターンを形成し、コイルパターンを形成した面の基板の面積に対する、コイルパターン及びダミーパターンの合計面積の比率を８０～９５％とすることを特徴とする。

【００１０】本発明の請求項２に係るプリントコイル用多層板の製造方法は、請求項１記載のプリントコイル用多層板の製造方法において、厚み４０～８０μｍの基板間絶縁層を形成して接着される、厚み９０～１５０μｍのコイルパターンを表面に形成した基板の、厚み９０～１５０μｍのコイルパターンを形成した表面のうち、コイルパターン及びダミーパターンを除く基板の表面が、その基板の端面とつながるようにダミーパターンを形成することを特徴とする。

【００１１】本発明の請求項３に係るプリントコイル用多層板の製造方法は、請求項１又は請求項２記載のプリントコイル用多層板の製造方法において、ダミーパターンの形状が、面積１～２５平方ｍｍの円形及び／又は角形が複数形成された形状であることを特徴とする。

【００１２】

【発明の実施の形態】本発明に係るプリントコイル用多層板の製造方法を図面に基づいて説明する。図１は本発明に係るコイルパターン及びダミーパターンの形状の一実施の形態を説明する図であり、図２は本発明に係るコイルパターン及びダミーパターンの形状の他の実施の形態を説明する図であり、図３は本発明に係るコイルパターン及びダミーパターンの形状の更に他の実施の形態を説明する図であり、図４は本発明に係るプリントコイル用多層板の製造方法の一実施の形態の工程を説明する断面図である。

【００１３】本発明のプリントコイル用多層板の製造方法は、その中の少なくとも２枚には厚み９０～１５０μｍの導体パターンを表面に形成した複数枚の有機系の基板と、熱硬化性樹脂をガラスクロスに含浸したプリプレグとを用いて、図４（ａ）に示すように、基板１，１表面に形成した厚み９０～１５０μｍのコイルパターン２，２がプリプレグ３を間に挟んで向かい合うように基板１，１及びプリプレグ３を積層した後、加熱加圧することにより、図４（ｂ）に示すように、厚み９０～１５０μｍのコイルパターン２，２が向かい合う間に厚み４０～８０μｍの基板間絶縁層４を形成して基板１，１が接着され、多層板は製造される。

【００１４】この厚み４０～８０μｍの基板間絶縁層４を形成して接着される、厚み９０～１５０μｍのコイルパターン２を表面に形成した基板は、図１に示すように、基板１の、厚み９０～１５０μｍのコイルパターン２を形成した表面のうち、コイルパターン２を形成した部分を除く表面にダミーパターン５を形成し、コイルパターン２を形成した面の基板１の面積に対する、コイルパターン２及びダミーパターン５の合計面積の比率を８０～９５％とすることが重要である。合計面積の比率が８０％未満の場合は、耐電圧が低下する場合があるため問題となり、９５％を越えるようにダミーパターン５を形成しようとすると、コイルパターン２とダミーパターン５が接触して電気特性が低下する場合がある。

【００１５】なお、ダミーパターン５の形状としては特に限定するものではないが、コイルパターン２やダミーパターン５によって周囲が閉鎖されることにより、コイルパターン２及びダミーパターン５を除く基板の表面６の部分が孤立して、加熱加圧するときプリプレグの熱硬化製樹脂が基板１の中央部から端部に向かって流れるときに、孤立した部分に気泡が残留しないように、図２に示すように、基板１のコイルパターンを形成した表面のうち、コイルパターン２及びダミーパターン５を除く基板の表面６が、その基板１の端面７とつながるようにダミーパターン５を形成すると、成形性が優れ好ましい。なおここでいう「コイルパターン２及びダミーパターン５を除く基板の表面６が、その基板１の端面７とつながる」とは、コイルパターン２及びダミーパターン５を除く基板の表面６が、コイルパターン２やダミーパターン５によって周囲が閉鎖されていないことを表す。また、図３に示すように、面積１～２５平方ｍｍの円形又は三角形，四角形等の角形のパターンを複数配して形成する場合、基板１表面に、ほぼ均一にコイルパターン２及びダミーパターン５を配置することができ、特に耐電圧が優れ好ましい。

【００１６】なお、本発明はコイルパターン２を表面に形成した有機系の基板１のうち、少なくとも２枚は厚み９０～１５０μｍのコイルパターン２を表面に形成した基板１である場合に限定される。９０～１５０μｍのコ

イルパターン２を表面に形成した基板１の枚数が２枚未満の場合は、コイルパターン２の断面積が小さくなって流せる電気容量が低下して電気特性が低下したり、コイルパターン２の幅を大きくして電気容量を満足させようとすると多層板の大きさが大きくなって価格的に問題となる。

【００１７】また、加熱加圧して厚み９０～１５０μｍのコイルパターン２が向かい合う間に厚み４０～８０μｍの基板間絶縁層を形成する場合に限定される。この基板間絶縁層の厚みが４０μｍ未満の場合は、耐電圧が低下する場合があり、８０μｍを越える場合は、電磁変換効率等の電気特性が低下する場合がある。

【００１８】本発明に用いられるコイルパターン２を表面に形成した有機系の基板１としては、片面又は両面にコイルパターン２を形成した有機系の板であればよく、例えば、エポキシ樹脂系、フェノール樹脂系、ポリイミド樹脂系、不飽和ポリエステル樹脂系、ポリフェニレンエーテル樹脂系等の熱硬化性樹脂や、これらの熱硬化性樹脂に無機充填材等を配合したもののシートの片面又は両面に金属箔が張られている板や、ガラス等の無機質繊維やポリエステル、ポリアミド、木綿等の有機質繊維のクロス、ペーパー等の基材を、上記熱硬化性樹脂等で接着し、片面又は両面に金属箔が張られている板等を用いて、金属箔をエッチングしてコイルパターン２を形成したもの、及び、金属箔が張られていない板の表面に金属メッキを行い、コイルパターン２を形成したもの等が挙げられる。なお、コイルパターン２を形成する金属としては、電気的信頼性より銅が好ましい。なお、この基板１は、必要に応じて内部にもコイルパターン２や他の回路パターンを有していてもよく、また、その壁面に導電皮膜を形成した穴を有していてもよい。

【００１９】本発明に用いられるプリプレグは、熱硬化性樹脂をガラスクロスに含浸したものであり、その熱硬化性樹脂としては、例えば、エポキシ樹脂系、フェノール樹脂系、ポリイミド樹脂系、不飽和ポリエステル樹脂系、ポリフェニレンエーテル樹脂系等の単独、変性物、混合物のように、熱硬化性樹脂全般が挙げられ、必要に応じてシリカ、炭酸カルシウム、水酸化アルミニウム、タルク等の無機質粉末充填材や、ガラス繊維、パルプ繊維、合成繊維、セラミック繊維等の繊維質充填材を含有していてもよい。なお、この熱硬化性樹脂は、ガラスクロスに含浸された後、必要に応じて加熱乾燥されていてもよい。

【００２０】なお、厚み９０～１５０μｍのコイルパターン２が向かい合う基板１の間に積層したプリプレグ中の熱硬化性樹脂の比率は、熱硬化性樹脂及びガラスクロスの合計１００重量部に対し、熱硬化性樹脂の量が６０～９０重量部であると好ましい。

【００２１】基板１の間にプリプレグを挟んで積層した後、加熱加圧する条件としては、プリプレグの熱硬化性樹脂が硬化する条件で適宜調整して加熱加圧すればよいが、加圧の圧力が高いとコイルパターン２に歪みが発生して複数枚の基板１，１・・間で位置ズレが発生して電気特性が低下する場合があるため、成形性を満足する範囲内で、できるだけ低圧で加圧することが好ましい。なお、加熱加圧を３００Ｔｏｒｒ以下の減圧雰囲気下で行うと、成形性が良好となり好ましい。

【００２２】加熱加圧した後、必要に応じて、図４（ｃ）に示すように、加熱加圧して得られた多層板に、コイルパターン２を貫通する穴１０を形成し、この穴１０にメッキ等により導電性物質１１を付与して、所望のコイルパターン２間や他の回路パターン間を電気的に接続したり、表層の金属箔をエッチングして、表層回路１２を形成したり、表層回路１２の上にソルダーレジスト層を形成してプリントコイルの製造を行う。

【００２３】なお、厚み９０～１５０μｍのコイルパターン２を形成した基板１は２枚に限定されるものではなく、更に複数の９０～１５０μｍのコイルパターン２を形成した基板１をプリプレグを挟んで積層していてもよいし、厚み９０μｍ未満のコイルパターンを形成した基板１を積層していてもよい。また、プリプレグを間に挟んで向かい合うように基板１及びプリプレグを積層した積層物の片側又は両側にプリプレグや金属箔を積層していてもよい。なお、これらの場合にも、厚み９０～１５０μｍのコイルパターン２が向かい合う間に厚み４０～８０μｍの基板間絶縁層を形成して接着される部分の基板１は、厚み９０～１５０μｍのコイルパターン２を形成した表面のうち、コイルパターン２を形成した部分を除く表面にダミーパターンを形成し、コイルパターン２を形成した面の基板１の面積に対する、コイルパターン２及びダミーパターンの合計面積の比率を８０～９５％とすることが重要である。

【００２４】

【実施例】

（実施例１）銅箔厚さ１０５μｍ、絶縁部の厚さ０．１ｍｍのエポキシ樹脂両面銅張り積層板［松下電工株式会社製、品名　Ｒ１７６６］を２枚用いて、その２枚の基板の銅箔を一方の面のみエッチングして、一方の面に導体の幅１ｍｍ、エッチング除去部の幅１ｍｍの渦巻き状コイルパターン６個と、ダミーパターンとして、図３に示すような、多数の面積１２平方ｍｍの円形のパターンをコイルパターンを形成した部分を除く表面に形成した基板を得た。

【００２５】得られた基板のコイルパターンを形成した面の基板の面積に対する、コイルパターン及びダミーパターンの合計面積の比率を求めたところ８５％であった。なおこの比率は、コイルパターンを形成する前の基板の重量と、一方の面のみエッチングしてコイルパターン及びダミーパターンを形成した後の重量と、一方の面のみエッチングしてコイルパターン及びダミーパターン

を形成した面の銅箔を全面除去した後の重量を、上記と同様のエポキシ樹脂両面銅張り積層板を用いて、重量を測定して計算することにより求めた。

【００２６】また、厚み０．０４ｍｍのガラスクロス［旭シュエーベル株式会社製、品名１０８０］に、下記のエポキシ樹脂２種類、硬化剤、硬化促進剤及び溶剤２種類よりなるエポキシ系樹脂を、乾燥後の熱硬化性樹脂の量が、熱硬化性樹脂及びガラスクロスの合計１００重量部に対し、７０重量部となるように調整して含浸した後、最高温度１８０℃で加熱乾燥してプリプレグＡを製造した。

・エポキシ樹脂１：エポキシ当量が５００であるテトラブロモビスフェノールＡ型エポキシ樹脂［東都化成株式会社製、商品名ＹＤＢ－５００］を固形分として９４重量部

・エポキシ樹脂２：エポキシ当量が２２０であるクレゾールノボラック型エポキシ樹脂［東都化成株式会社製、商品名ＹＤＣＮ－２２０］を固形分として１３重量部

・硬化剤：ジシアンジアミドを２．８重量部

・硬化促進剤：２－エチル－４－メチルイミダゾールを０．１重量部

・溶剤１：Ｎ，Ｎ－ジメチルホルムアミドを５５重量部

・溶剤２：メチルエチルケトンを２００重量部。

【００２７】次いでこの基板に粗化処理を行った後、基板表面に形成した厚み１０５μｍのコイルパターンが向かい合うように基板を配置した後、その基板の間に厚み上記プリプレグＡを２枚挟んで積層し、次いでこの積層物を金属プレートで挟み、最高温度１７０℃、圧力３ＭＰａの条件で９０分加熱加圧して多層板を得た。

【００２８】得られた多層板をコイルパターンのある部分で切断してコイルパターンの断面を露出し、切断面を研磨した後、１００倍の顕微鏡により観測して、厚み１０５μｍのコイルパターンが向かい合う部分の基板間絶縁層の厚みを５カ所測定して平均値を求めたところ７０μｍであった。

【００２９】（実施例２）乾燥後の熱硬化性樹脂の量が、熱硬化性樹脂及びガラスクロスの合計１００重量部に対し、６５重量部となるように調整して含浸してプリプレグＢを製造したこと、及び、基板表面に形成した厚み１０５μｍのコイルパターンが向かい合うように基板を配置した後、その基板の間に、プリプレグＢを２枚挟んで積層したこと、及び、加熱加圧を５０Ｔｏｒｒの減圧雰囲気下で行ったこと以外は実施例１と同様にして多層板を得た。

【００３０】得られた多層板を実施例１と同様にして、厚み１０５μｍのコイルパターンが向かい合う部分の基板間絶縁層の厚みを測定したところ６５μｍであった。

【００３１】（比較例１）基板の銅箔を一方の面のみエッチングして、一方の面に導体の幅１ｍｍ、エッチング除去部の幅１ｍｍの渦巻き状コイルパターン６個のみ形成した基板を用いたこと以外は実施例１と同様にして多層板を得た。得られた基板のコイルパターンを形成した面の基板の面積に対する、コイルパターンの比率を求めたところ５０％であった。

【００３２】得られた多層板を実施例１と同様にして、厚み１０５μｍのコイルパターンが向かい合う部分の基板間絶縁層の厚みを測定したところ５０μｍであった。

【００３３】（比較例２）面積１２平方ｍｍの円形のパターンの数を減らすことによりダミーパターンの形状を変更して形成した基板を用いたこと以外は実施例１と同様にして多層板を得た。得られた基板のコイルパターンを形成した面の基板の面積に対する、コイルパターン及びダミーパターンの合計面積の比率を求めたところ７０％であった。

【００３４】得られた多層板を実施例１と同様にして、厚み１０５μｍのコイルパターンが向かい合う部分の基板間絶縁層の厚みを測定したところ６０μｍであった。

【００３５】（評価、結果）実施例１，２及び比較例１，２で得られた多層板の耐電圧及び耐熱性を測定した。耐電圧の測定は、用いた２枚の基板のコイルパターンを、各々銅張り積層板の絶縁部であった部分及びコイルパターンを形成しなかった面の銅箔を削り取ることにより一部を露出させた。次いでこの多層板を２３±５℃に保温されたオイル中に浸漬した状態で、用いた２枚の基板のコイルパターンの間に、一部露出したコイルパターンの部分から毎秒１００Ｖの昇圧条件で電圧を印加し、絶縁破壊が起きる電圧を測定した。耐熱性の測定は、ＪＩＳ　Ｃ６４８１に従い、オーブンで６０分処理した。

【００３６】結果は、表１に示した通り、各実施例は各比較例と比較して耐電圧が優れており、耐電圧は同等であることが確認された。

【００３７】

【表１】

表１

	実施例		比較例	
	1	2	1	2
銅箔厚み　(μm)	105	105	105	105
ﾊﾟﾀｰﾝ比率　(%)	85	85	50	70
プリプレグ	A	B	A	A
樹脂比率　(%)	70	65	70	70
ﾌﾟﾘﾌﾟﾚｸﾞ枚数　(枚)	2	2	2	2
基板間絶縁層の厚み　(μm)	70	65	50	60
耐電圧　(kV)	5.0	5.3	0.7	1.2
耐熱性　(℃)	235	235	220	225

【００３８】

【発明の効果】本発明に係るプリントコイル用多層板の製造方法は、向かい合う厚み９０～１５０μmの導体パターンの間に挟んで積層したプリプレグのガラスクロスが、重量１５～６０ｇ／平方mのガラスクロスであり、かつ、そのプリプレグの枚数が２～５枚であるため、耐電圧が優れたプリント配線板を得ることができる。

【図面の簡単な説明】

【図１】本発明に係るコイルパターン及びダミーパターンの形状の一実施の形態を説明する図である。

【図２】本発明に係るコイルパターン及びダミーパターンの形状の他の実施の形態を説明する図である。

【図３】本発明に係るコイルパターン及びダミーパターンの形状の更に他の実施の形態を説明する図である。

【図４】本発明に係るプリントコイル用多層板の製造方法の一実施の形態の工程を説明する断面図である。

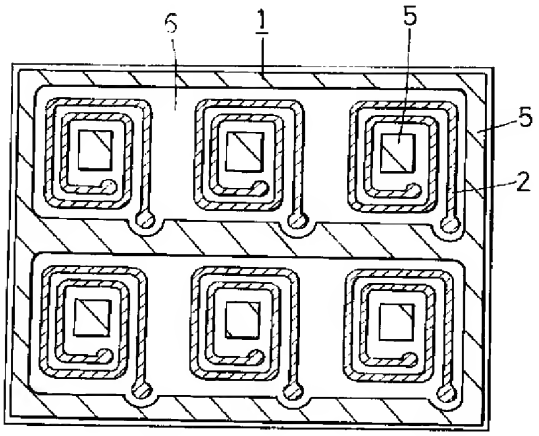
【図５】コイルパターンの一従来例を説明する図である。

【図６】コイルパターンの他の従来例を説明する図である。

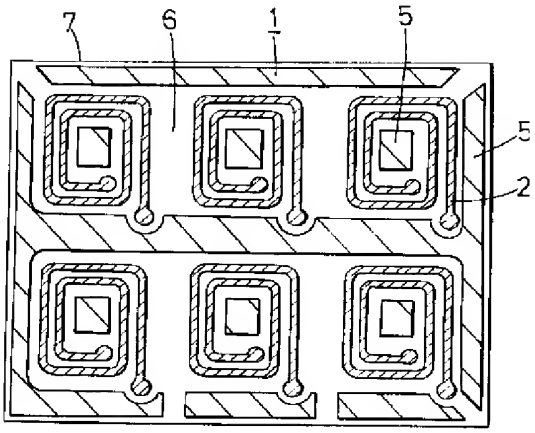
【符号の説明】

１　基板
２　コイルパターン
３　プリプレグ
４　基板間絶縁層
５　ダミーパターン

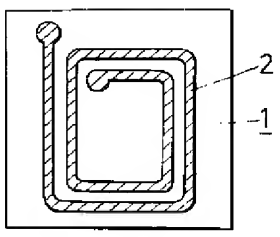
【図１】



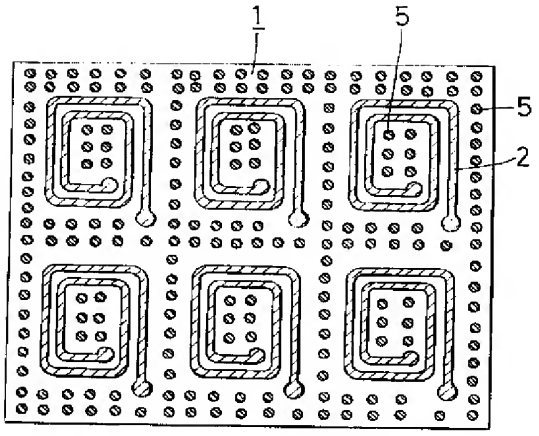
【図２】



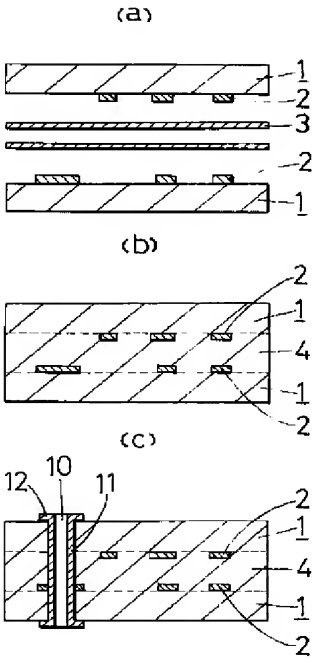
【図５】



【図３】



【図４】



【図６】